

THE BITING MIDGES OF ALDABRA ATOLL, INDIAN OCEAN
(DIPTERA: CERATOPOGONIDAE)

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Abstract.—Eighteen species of biting midges are recorded from Aldabra Atoll, Indian Ocean, of which three are described as new: *Dasyhelea cogani*, *D. hutsoni*, and *Culicoides adamskii* Spp. N. These and two previously described species, *Forcipomyia hutsoni* Wirth and Ratanaworabhan and *Metacanthohelea cogani* Wirth and Grogan, are endemic to Aldabra. The low degree of endemism (27%) in the Aldabra midges is contrasted with the Seychelles species, where 37 of 43 species are endemic (86%). Although incomplete collections make these figures tentative, they can partially be explained by the Seychelles' geographic isolation and elevationally varied habitats, in contrast with Aldabra's position relatively close to the African continent and elevationally uniform, low atoll environment.

Key Words: biting midges, Ceratopogonidae, Aldabra Atoll

The biota of the islands and atolls of the Indian Ocean has interested naturalists and geographers since the earliest European explorations reported the occurrence of large flightless birds and giant tortoises (Abbott 1893). Studies of the insect fauna have lagged far behind and it is only in recent years that comprehensive collections have been made. One striking exception was the Percy Sladen Trust Expedition to the Indian Ocean in 1905-1909, the entomological results of which were summarized by Scott (1933). More recently Legrand (1965) reported comprehensively on the Lepidoptera that he collected on the Seychelles and Aldabra from 1956 to 1960.

Beginning in 1966 the Royal Society of London established a scientific research station on Aldabra Atoll and began extensive collections. A comprehensive report on their research was published under the editorship of Westoll and Stoddart (1971). Preliminary studies on the affinities and composition of the insect fauna of Aldabra were published as a part of this report by Cogan et al. (1971). Peake (1971) also presented his analysis of

the evolution of terrestrial faunas in the western Indian Ocean as part of this report. Later, Stoddart and Westoll (1979) edited a comprehensive report on the terrestrial ecology of Aldabra, in which Frith (1979) summarized a 12-month study of insect abundance and composition on the atoll.

Brian Cogan and Tony Hutson sent me their 1967 Aldabra biting midge collections (Diptera: Ceratopogonidae) for study in 1969, but I was reluctant to publish promptly because the ceratopogonid fauna of the western Indian Ocean islands, Madagascar, and the adjacent African continent was so poorly known. In the meantime Wirth et al. (1980) catalogued the Sub-Saharan Ceratopogonidae, and several important papers were published, among which the following deserve mention: Clastrier (1959) on the biting midges of Réunion, de Meillon (1961) on Madagascar, and Wirth and Messersmith (1977) and Clastrier (1983) on the Seychelles. Frith (1979) reported that her trap collections in several localities included large numbers of Ceratopogonidae but these were not identified further, and it was not

Table 1. Numbers of genera, species, endemic species, and percent endemism in Ceratopogonidae of certain western Indian Ocean land masses.

	Number of Genera Reported	Number of Species Reported	Number of Endemic Species	Percent Endemism
Entire Afrotropical Region (Wirth et al. 1980)	34	622	NA ^a	NA
Madagascar (de Meillon 1961)	12	31	10	32%
Seychelles (Clastrier 1983)	14	43	37	86%
Réunion (Clastrier 1959)	5	15	5	33%
Aldabra (present study)	7	18	5	27%

^a Not applicable.

possible to sort them out from their bulk storage in the British Museum (Nat. Hist.) and include them in the present study. David Adamski of Starkville, Mississippi, collected on Aldabra Atoll in 1986, producing a good collection of midges that he took at light, which has been included in this study.

Previously only three species of biting midges were recorded from Aldabra Atoll: *Forcipomyia hutsoni* Wirth and Ratana-worabhan (1976), *Dasyhelea nigricans* Carter, Ingram & Macfie and *Stilobezzia spirogyrae* Carter, Ingram & Macfie (reported in Wirth et al. 1980). In the present study I report 18 species in seven genera from Aldabra, of which three species were previously undescribed and five are endemic to Aldabra.

A comparison with the number of genera, species, and endemic species reported elsewhere in the western Indian Ocean and Sub-Saharan Region as a whole is given in Table I. As stated above, a fair comparison cannot be made, since so little is known of the Madagascar fauna, but one cannot fail to be impressed by the high degree of endemism (86%) in the species of the isolated, high elevation, Seychelles Islands compared with the low endemism (27%) in the low Aldabra Atoll which lies closer to the African continent.

The systematic arrangement used here follows that given in the Sub-Saharan Catalogue by Wirth et al. (1980), except that following Wirth and Grogan (1988) the tribes Ceratopogonini and Stilobezziini are

combined in one tribe, the Ceratopogonini. Keys to the genera may be found in Wirth et al. (1974). Explanation of the taxonomic characters used can be found in the general papers on Ceratopogonidae by Wirth (1952) and Downes and Wirth (1981).

Holotypes of material collected by Cogan and Hutson are deposited in the British Museum (Natural History), London (BMNH); that collected by Adamski is in the National Museum of Natural History, Smithsonian Institution, Washington (USNM). Some paratypes, and other material as specified, are deposited in the Museum National d'Histoire Naturelle in Paris (PARIS).

Adamski's Aldabra material was collected by permission of Mr. Lindsay Chong-Seng, Ministry of Development and Natural Resources, Victoria, Mahe, Republic of Seychelles, and under the auspices of the Smithsonian Institution Expedition to Aldabra Atoll (1986), Dr. Brian Kensley, Smithsonian Institution, Leader. The Kenya specimens of *Forcipomyia vesicula* de Meillon & Wirth were made available by Professor D. S. Kettle from material collected by Dr. R. Harmsen on the University College Nairobi, Mount Kenya Expedition, March 1966.

SUBFAMILY FORCIPOMYIINAE

Forcipomyia (*Forcipomyia*) *callithorax* (Kieffer), 1911.

Ceratopogon lasionotus var. *callithorax* Kieffer, 1911: 335 (♂, ♀; Seychelles).

Forcipomyia lasionota var. *callithorax* (Kieffer); Ingram & Macfie, 1924: 545 (combination; in key).

Forcipomyia (*Forcipomyia*) *callithorax* (Kieffer); Clastrier, 1983: 39 (redescribed; figs.; Seychelles, from types).

Diagnostic characters.—A small, pale brown, unmarked species with pale yellowish legs. Female: Wing length 0.90 mm; costal ratio 0.46; hind tarsal ratio 1.00. Wing without pale markings, macrotrichia long and abundant on costa and radius, less prominent on rest of wing; halter pale. Antenna pale brown; antennal ratio (11–15/3–10) 1.10. Palpus pale brown; lengths of segments in proportion of 12–22–58–25–22; third segment swollen to tip with small, deep pit; palpal ratio 2.0. Mandible slender, hyaline and distally pointed, with a distal series of microscopic teeth too fine to be counted, possibly 20–30 in series. Body without short broad striated scales. One spermatheca present; elongate with long tapering neck; measuring 0.124 by 0.072 mm.

Distribution.—Aldabra, Seychelles.

Material examined.—ALDABRA ATOLL: West Island (Ile Picard), Settlement, 12–22.iii.1986 (*D. Adamski*), 1 ♀ (USNM).

Forcipomyia (*Forcipomyia*) *vesicula* de Meillon & Wirth, 1983.

Forcipomyia (*Forcipomyia*) *vesicula* de Meillon & Wirth, 1983: 350 (♂, ♀; South Africa; figs.).

Diagnostic characters.—A moderately large, stout, dull, pale brown species with unmarked wing and legs; mesonotum with three broad, obscurely darker brown vittae. Female: Wing length 1.1–1.5 mm; costal ratio 0.45. Antenna brown, distal segments scarcely elongated, antennal ratio 0.75. Palpus yellowish, becoming brownish distally; third segment slightly swollen on proximal half; palpal ratio 2.7. Hind tarsal ratio 1.0. Spermathecae two, large, slightly unequal, measuring 0.340 by 0.144 mm and 0.270

by 0.125 mm; faintly pigmented, bladder-like, ovoid to spindle-form in shape, with short, slender, abruptly bent necks. Male: Genitalia yellowish, contrasting with dark brown proximal abdominal segments; aedeagus pale, shape as usual in the subgenus; parameres pale, with bases fused in a broad plate to a third of total length, stout and slightly sinuate distally, apices tapered to a fine point slightly curved laterad.

Types.—Augrabies Falls, Gordonian Dist., Cape Province, SOUTH AFRICA, 27–28.x.1980, (de Meillon & Van Eeden) (type in Natal Museum).

Distribution.—Aldabra, Kenya, South Africa.

Material examined.—ALDABRA ATOLL: South Island; Cinq Cases, 3–16.i.1968, at light, 1 ♀; Takamaka Pool, 1–17.ii.1968, at light, 2 ♂, 2 ♀ (Cogan & Hutson) (BMNH); West Island (Ile Picard), Settlement, 12–22.1986 (*D. Adamski*), UV light trap, 15 ♂, 24 ♀ (BMNH, USNM, PARIS: Mississippi State Mus.). KENYA: Mt. Kenya, 3900 m, 19.iii.1966 (*R. Harmsen*), reared from lower woody stem of decayed *Lobelia kenienensis*, 1 ♂, 2 larvae, 1 pupal exuviae (BMNH).

Forcipomyia (*Lepidohelea*) *lepidota* Ingram & Macfie, 1924.

Forcipomyia lepidota Ingram & Macfie, 1924: 566 (♂, ♀; Gold Coast; figs.); Clastrier, 1956: 506 (redescribed; figs.; Tunisia, Algeria); Dessart, 1961: 362 (redescribed; figs.; synonymy); Dessart, 1963: 82 (redescribed; figs.; synonymy).

Diagnostic characters.—A dark brown species with banded legs including a median yellowish band on hind femur. Hind tarsal ratio of female 0.90, of male 0.82. Male genitalia with dististyle swollen distally with very characteristic, obliquely capitate expansion; aedeagus also with specifically diagnostic distal expansion, the basal arch very low, nearly transverse; parameres separate, the long posterior processes tapering to slender, slightly sinuate rods.

Distribution.—Widespread in Sub-Saharan and Oriental Regions.

Material examined.—ALDABRA ATOLL: South Island; Dune Jean-Louis, 13–20.iii.1968, 1 ♀; Takamaka Grove, 1–17.ii.1968, 1 ♂ (USNM), 1 ♀ (BMNH), (Cogan & Hutson).

This species has been very well redescribed and figured by Clastrier (1956) and Dessart (1961). According to Clastrier (1983), *Forcipomyia chrysolopha* (Kieffer) is a distinct species readily distinguished by the stouter, straight, posterior processes of the parameres and by the stouter, non-tapering, distal portion of the aedeagus.

Forcipomyia (Microhelea) fuliginosa (Meigen), 1818.

Ceratopogon fuliginosus Meigen, 1818: 86 (Germany).

Forcipomyia fuliginosa (Meigen): Goetghebuer, 1933: 130 (combination; Congo); Wirth, 1956: 357 (distribution; insect feeding records; synonymy); Dessart, 1963: 63 (redescribed; Africa; figs.; synonymy); Wirth, 1972: 567 (redescribed; figs.; synonymy; distribution; Neotropical records).

Distribution.—Worldwide.

Material examined.—ALDABRA ATOLL: South Island, Takamaka Pool, 1–17.ii.1968, (Cogan & Hutson), 1 ♀ (BMNH).

This species is a widely distributed, common parasitic species sucking haemolymph from a wide variety of smooth-bodied caterpillars and sawfly larvae, especially larvae of Sphingidae. Closely resembling species of the subgenus *Forcipomyia*, but with short basitarsi (tarsal ratio about 0.50); third palpal segment elongate and swollen nearly to tip, with deep pit extending nearly the length of segment; palpal segment 4 much longer than 5; mandible with numerous (30–35) fine teeth; and the male parameres fused for nearly half of total length.

Forcipomyia (Pterobosca) hutsoni Wirth & Ratanaworabhan, 1976.

Forcipomyia (Pterobosca) hutsoni Wirth & Ratanaworabhan, 1976: 242 (all stages; Aldabra; figs.).

Types.—Holotype ♀, ALDABRA ATOLL, South Island, Cinq Cases, 3–16.i.1968, (Cogan & Hutson) (BMNH). Paratypes, 59 ♀, 1 ♂, 22 larvae, 2 pupae, same data (BMNH, USNM).

Distribution.—Aldabra.

Forcipomyia hutsoni was described from material collected by Cogan and Hutson on Aldabra. Most of the females were attached to the wings of dragonflies from which meals of haemolymph are taken; the male was collected at light, and the presumed larvae and pupae were collected in leaf axils of *Pandanus*. Of the related species of the subgenus *Pterobosca*, the closest is *Forcipomyia ariel* (Macfie), known only from the Moluccas in Indonesia.

SUBFAMILY DASYHELEINAE

Dasyhelea fenerivensis de Meillon, 1961.

Dasyhelea fenerivensis de Meillon, 1961: 12 (♂, Madagascar; fig. genitalia).

Type.—Holotype ♂, Fenerive, Madagascar, xii.1955, B. Stuckenberg, at light on beach (in Inst. Rech. Sci. Madagascar).

Distribution.—Aldabra, Madagascar.

Material examined.—ALDABRA ATOLL: South Island, Takamaka Grove, 1–17.ii.1968, 1 ♂ (USNM); Frigate Pool, 20.i.1968, 1 ♂ (BMNH) (all Cogan & Hutson).

This species belongs to the *Dasyhelea nigricans* Group and is readily separable from all other members of the group by the bifid apex of the posterior projection of the parameres. *Dasyhelea borbonica* Clastrier (1959) from Réunion is similar but has the ninth sternum produced caudad over the aedeagus in a blunt point, the paramere has a slender tip with a short slender subapical projection, the aedeagus is not so strongly sclerotized on the lateral margins, and the

dististyle bears a slender, distally directed, mesal process near the base.

Dasyhelea inconspicua Carter, Ingram & Macfie, 1921.

Dasyhelea inconspicua Carter, Ingram & Macfie, 1921: 191 (all stages; figs.; Ghana).

Diagnostic characters.—A small, dark brown species with yellowish scutellum, brownish legs, and infuscated halteres. Wing length 0.7–0.9 mm; costal ratio 0.43; macrotrichia long and abundant. Female spermatheca small (0.032 mm diameter) and subspherical with a short neck (0.005 mm). Male genitalia nearly as broad as long, ninth tergum with slender apicolateral processes; ninth sternum with narrow median projection over base of aedeagus; aedeagus with small, strongly sclerotized, transverse basal sclerite, a small rounded black median sclerite, and a short slender pair of submedian processes with slender tips hooked ventrad. Parameres with stout, slightly asymmetrical basal apodemes, the median posterior process poorly developed.

Distribution.—Widespread in Subsaharan Region from Ghana to Mozambique and the Sudan; Aldabra.

Material examined.—ALDABRA ATOLL: South Island, Dune Jean-Louis, 13–20.iii.1968, at light (Cogan & Hutson), 2 ♂ (BMNH, USNM).

Dasyhelea monosticta (Ingram & Macfie),

NEW COMBINATION

Thysanognathus monostictus Ingram & Macfie, 1923: 60 (♀; Zanzibar; figs.); Macfie, 1938: 159 (compared with *Dasyhelea atronotata* Macfie from Solomon Islands; ? *Dasyhelea*).

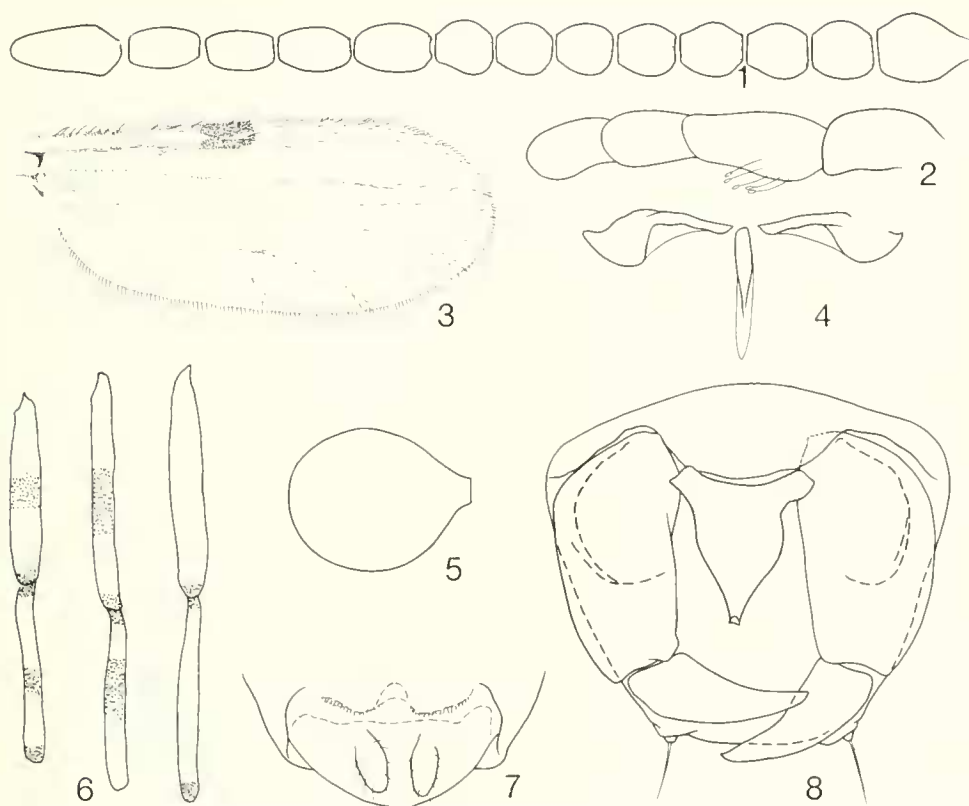
Alluaudomyia monosticta (Ingram & Macfie); de Meillon, 1939: 9 (combination; in key).

Types.—Four ♀ syntypes, ZANZIBAR, Prison, 1.xii.1918 (Dr. W. M. Aders) (BMNH). Dr. John Boorman in March 1980 examined and photographed three ♀ syntype slides (two more or less complete specimens

and one with a wing only) which appear to be all that remain of the type series. Selected photographs of these syntypes shown in Figs. 9–13 indicate without doubt that the species belongs in the genus *Dasyhelea* (NEW COMBINATION). They also indicate that our Aldabra material is conspecific, and I can now supplement the original description and add the description of the hitherto unknown male.

Female.—Wing length 0.83 mm; breadth 0.36 mm; costal ratio 0.48. A small, pollinose, pale brown species with faint brownish vittate markings on mesonotum, and scutellum dark in middle. Legs (Figs. 6, 11) whitish with black knee spots and moderately distinct brownish bands on midportions of fore and mid femora and tibiae; extreme apices of tibiae and all tarsomeres slightly infuscated. Wing (Figs. 3, 10) whitish hyaline, a single dark brown spot on anterior margin over second radial cell, the latter well formed; macrotrichia sparse and pale, scarcely distinguishable. Halter with white knob. Antenna (Fig. 1) pale brown; short and stout, proximal segments nearly moniliform, no sharp break in length between 10 and 11; lengths of flagellar segments in proportion of 30-22-20-20-20-20-20-22-22-20-20-41; segments with proximal reticulations; antennal ratio 0.74; last segment with blunt tip. Palpus (Fig. 2) short and stout; lengths of segments in proportion of 19-24-14-14. Abdomen brownish with narrow pale segmental bands; genital sclerotization (Fig. 7) a small transverse brownish plate surrounding gonopore, with slender, sinuate lateral arms. Spermatheca (Fig. 5) one, ovoid with short tapering neck; small, measuring overall 0.036 by 0.029 mm.

Male.—Wing length 0.88 mm; breadth 0.33 mm; costal ratio 0.46. Similar to the female with the usual sexual differences. Antenna with sparse brownish plume extending to segment 12; segments 3–12 more or less fused; lengths of flagellar segments in proportion of 35-22-18-18-18-18-18-



Figs. 1-8. *Dasyhelea monosticta*. 1-3, 5-7 female; 4, 8 male: 1, antenna; 2, palpus; 3, wing; 4, parameres; 5, spermatheca; 6, femora and tibiae of (left to right) fore, mid and hind legs; 7, genital sclerotization; 8, genitalia, parameres omitted.

18-36-33-33-50, antennal ratio (12-15/3-11) 0.83. Palpus with lengths of segments in proportion of 11-10-30-20. Genitalia (Fig. 8) slightly broader than long, in ventral view nearly circular in outline because of the rounded ninth tergum which lacks distinct apicolateral processes; ninth sternum narrow with mesal expansion to base of aedeagus; basistyle about twice as long as broad, slightly tapering distally; dististyle short, stout at base, tapering abruptly to pointed tip; aedeagus shield-shaped, slightly longer than basal breadth, well sclerotized on anterior margin with short, stout lateral arms, tapering distally with convex lateral margins to slender tip bent ventrocaudad. Parameres (Fig. 4) symmetrical; basal apo-

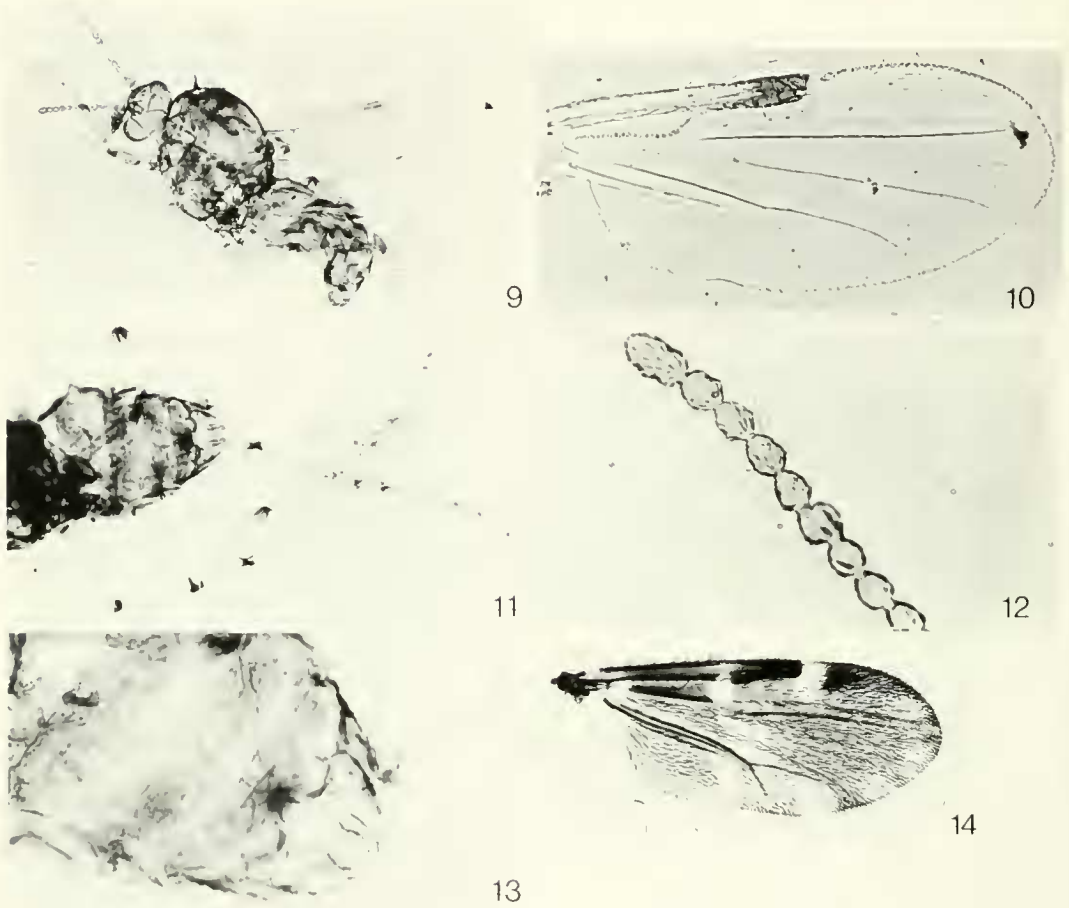
demes rather stout laterally, only slightly bent, tapering mesad to slender junction with the small, slender, straight, rodlike posterior process with pointed tip.

Distribution.—Aldabra, Zanzibar.

Material examined.—ALDABRA ATOLL: South Island, Point Hodoul, 21.i.1968, large tidal solution hole, 10 ♀, 200 ♂; same, swarming in large tidal solution hole, approximately 1000 ♂, ♀; same, 27.i.1968, tidal saline pool, 2 ♂, 5 ♀ (all Cogan & Hutson) (BMNH, USNM, PARIS).

Dasyhelea nigricans Carter, Ingram & Macfie, 1921.

Dasyhelea nigricans Carter, Ingram & Macfie, 1921: 194 (♂; Ghana; fig. genitalia);



Figs. 9–13. *Dasyhelea monostieta*, female syntypes from Zanzibar: 9, whole mount; 10, wing; 11, abdomen and legs; 12, antennal segments 7–15; 13, distal abdominal segments. Fig. 14, *Culicoides adamskii*, wing of female paratype.

Ingram & Macfie, 1921: 328 (♀; Nigeria); Clastrier, 1959: 417 (♂ redescribed; fig. genitalia; Réunion); Clastrier & Wirth, 1961: 321 (redescribed; Gambia; figs.).

Distribution.—Aldabra, Ethiopia, Gambia, Ghana, Nigeria, Réunion, Transvaal.

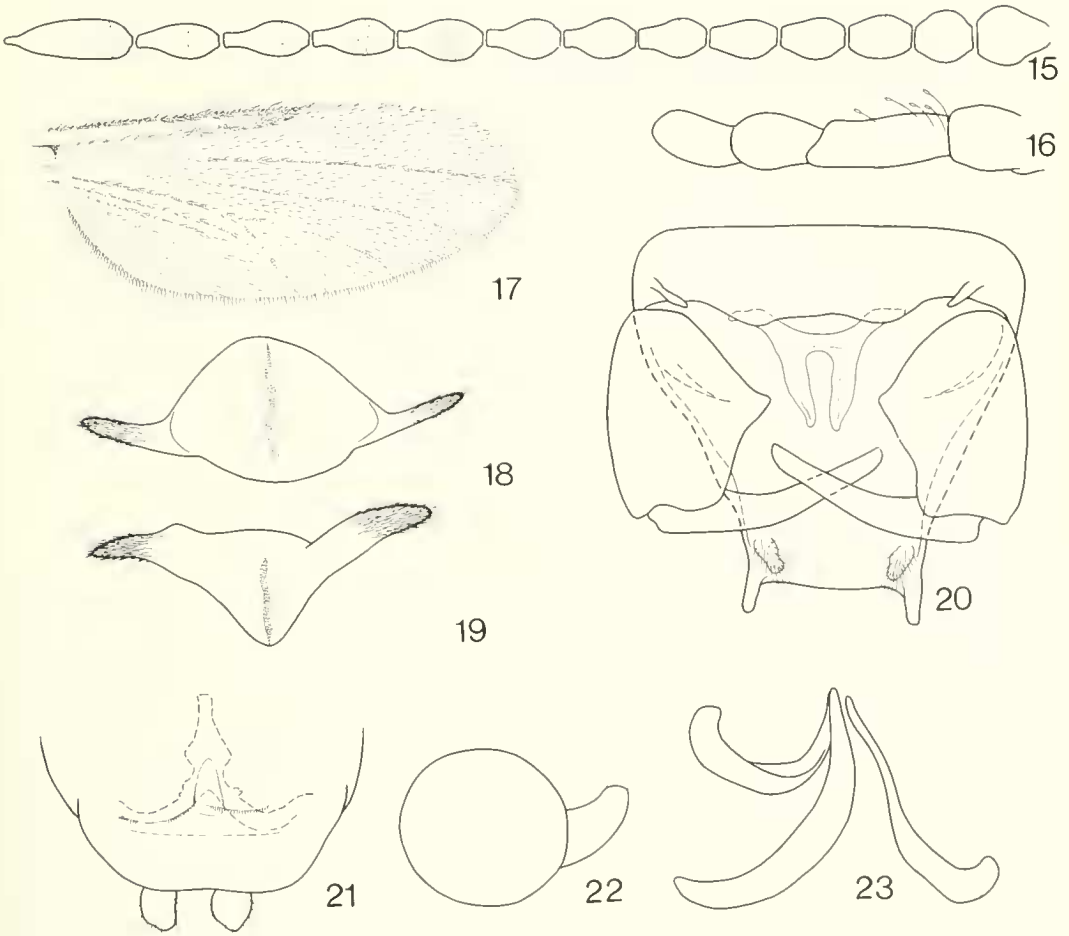
Material examined.—ALDABRA ATOLL: South Island, Cinq Cases, 23–29.i.1968, (Cogan & Hutson), 1 ♂, 1 ♀ (BMNH).

This small dark species is recognized by its yellow legs and deeply two-pronged male dististyle.

Dasyhelea speciosa Clastrier, 1983

Dasyhelea speciosa Clastrier, 1983: 34 (♀; Seychelles; figs.)

Diagnostic characters.—Wing length 1.10–1.20 mm; costal ratio 0.56. A moderately large dark brown species with bluish-green pollinose thorax; scutellum yellowish, brownish in center. Legs yellowish brown with blackish knee spots and faint, broad, median brownish bands on femora and tibiae. Halter infuscated. Wing (Fig. 17) with abundant macrotrichia; second radial cell



Figs. 15–23. *Dasyhelea speciosa*: 15–18, 21–22, female; 19–20, 23, male: 15 antenna; 16, palpus; 17, wing; 18, 19, precoxal bridge; 20, genitalia, parameres omitted; 21, genital sclerotization; 22, spermatheca; 23, parameres.

lenticular; end of costa oblique. Antenna (Fig. 15) with all flagellar segments moderately elongated and tapering, more so toward apex; last segment with distinct terminal appilla; flagellar segments with distinct coarse reticulations (plaques) proximad of the verticils, distal portions of segments 11–15 without pubescence. Palpus (Fig. 16) moderately stout. Precoxal bridge (Fig. 18 female, Fig. 19 male) an oval to somewhat triangular transverse sclerite with ends elongated and tapered and bearing dense pubescence. Female subgenital plate

(Fig. 21) with undulating caudolateral arms and anteromedian projection elongated with distinct basal constriction. Spermatheca (Fig. 22) ovoid to subspherical, measuring 0.080 by 0.076 mm, with long oblique slender neck measuring 0.043 mm long. Male genitalia (Fig. 20, 23) indistinguishable from that described by Wirth & Messersmith (1977) for *D. seychellensis* (Kieffer).

Types.—Clastrier (1983) designated as holotype the specimen from Beau Vallon, Mahe, Seychelles, 25.iv.1963, (Tams & Nye) (BMNH) from a series of four females from

the same locality with different dates that had been described and figured by Wirth & Messersmith (1977) under the name *D. seychellensis* (Kieffer).

Distribution.—Aldabra, Seychelles.

Material examined.—ALDABRA ATOLL: South Island, Cinq Cases, 3–16.i.1968, 1 ♂; Dune Jean-Louis, 13–20.iii.1968, shoreline on beach, 1 ♂, 1 ♀; Takamaka, 1–17.ii.1968, 3 ♂, 3 ♀. West Island, near Settlement, 21–31.iii.1968, at light, 1 ♂; Ile Picard Settlement, 12–22.iii.1986 (D. Adamski), 1 ♀. ASTOVE ATOLL: Coconut Plantation, 5.iii.1968, 2 ♂, 1 ♀. (All Cogan & Hutson except as noted; BMNH, USNM, PARIS.)

Kieffer (1911) described *D. seychellensis* from two specimens from Mahe, Seychelles: One female, Cascade Estate, about 1000 feet and over; and one male, Cascade Estate, about 800–1500 feet, 1909. Wirth and Messersmith (1977) selected the male as lectotype and described and figured the genitalia. They described and figured the female of the species from four females collected by Tams and Nye at Beau Vallon, Mahe, 12–30.iv.1965. Clastrier (1983) in his revision of the Seychelles Ceratopogonidae found that Kieffer's original female from Cascade Estate differed markedly (as outlined in his key) from the females described by Wirth & Messersmith, and described as *D. speciosa* sp. n. the Tams and Nye specimens, along with three females collected by Brown, on Silhouette, Seychelles. The Aldabra females reported here agree perfectly with the female of *D. speciosa* Clastrier, but the associated males cannot be separated from the male lectotype of *D. seychellensis* described by Wirth & Messersmith. It is possible that the female described by Clastrier as *D. speciosa* is the true female of *D. seychellensis* and that the Kieffer's female described by Clastrier as *D. seychellensis* is another unnamed species, but it is also possible that the males of the two species are indistinguishable. Further collections are necessary to resolve the possible synonymy.

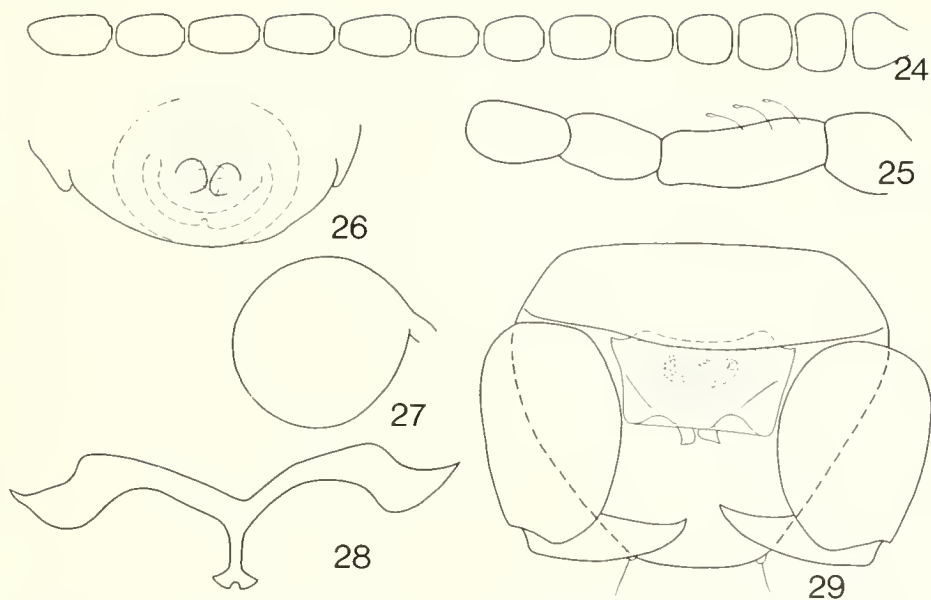
FEMALES OF *D. SEYCHELLENSIS*
AND *D. SPECIOSA* CAN BE
SEPARATED AS FOLLOWS:

1. Antennal segments 11–15 without microscopic pubescence, with very prominent reticulations (plaques) proximad of the verticils; anterior process of subgenital plate elongate and narrowed at the base; spermatheca retort-shaped with oblique, long slender neck *speciosa* Clastrier
- Antennal segments 11–15 with microscopic pubescence present their entire length; plaques poorly formed proximad of the verticils; anterior process of subgenital plate short with parallel margins; spermatheca subglobose to pyriform *seychellensis* (Kieffer)

Dasyhelea cogani Wirth,
NEW SPECIES

Female allotype.—Wing length 0.64 mm, breadth 0.32 mm; costal ratio 0.46. A very small, intensely dark brown species with brownish legs and halteres, and smoky pale brownish wings. Antenna (Fig. 24) short and stout; flagellar segments in nearly continuous series, lengths of segments in proportion of 21-16-16-17-17-17-17-20-20-20-20-25, antennal ratio 0.76; last segment bluntly pointed. Palpus (Fig. 25) short and stout, lengths of segments in proportion of 12-26-17-20. Hind tarsal ratio 2.6. Mesonotum dark brown, scutellum yellowish brown. Wing short and broad, smoky brownish, veins brown; macrotrichia long and coarse, moderately dense, arrangement in sparse rows; first radial cell vestigial, second slit-like. Abdomen dark brown, pleural membrane with black microsetae arranged in close-set, microscopic rows. Genital sclerotization (Fig. 26) in form of an anteromedian sclerotized loop with slender caudolateral arms. Spermatheca (Fig. 27) one, well pigmented, subspherical; small, measuring 0.033 mm in diameter, with a short, slender, oblique neck 0.007 mm long.

Male holotype.—Wing length 0.81 mm; breadth 0.32 mm; costal ratio 0.50. Similar to female with the usual sexual differences; larger and more slender; wing with second



Figs. 24–29. *Dasyhelea cogani*; 24–27, female; 28–29, male; 24, antenna; 25, palpus; 26, genital sclerotization; 27, spermatheca; 28, parameres; 29, genitalia, parameres omitted.

radial cell open; legs with longer vestiture. Antenna with dense plume of long brown verticils extending to segment 14, segments 3–12 more or less fused; lengths of flagellar segments in proportion of 35–26–22–22–22–23–23–25–25–56–56–48–50, antennal ratio (12–15/3–11) 0.97. Hind tarsal ratio 2.2. Genitalia (Fig. 29): Short and broad, much broader than long; ninth sternum with straight caudal margin; ninth tergum rounded caudally without distinct apicolateral processes. Basistyle short and stout, with patch of strong setae on ventromesal face near apex; dististyle short and stout, slightly curved and tapering distally to a sharp point. Aedeagus with narrow, sclerotized anterior bar joining short lateral arms; main body a transverse, quadrate, sclerotized plate ventrally, a pair of short, distally attenuated, sclerotized processes extending caudally from basal bar, their apices closely approximated, and dorsomost, a small, somewhat arcuate, transverse sclerite. Parameres (Fig. 28) symmetrical, basal apodemes irregularly arched anteriorly, becoming more slender

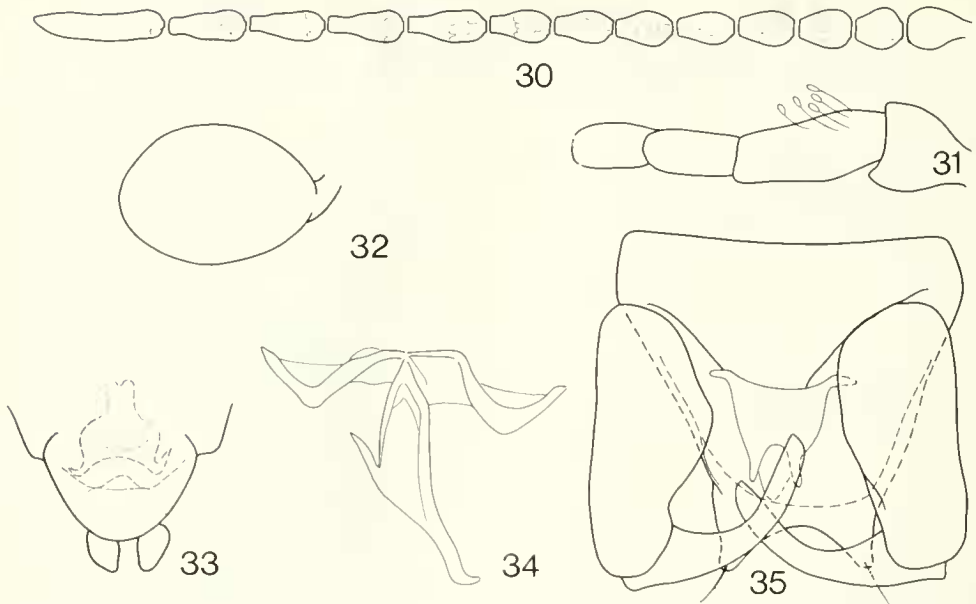
mesad and joining on midline and giving rise to a slender posterior process with a small, expanded, buttonlike, slightly bilobed tip.

Distribution.—Aldabra, Astove Atolls.

Types.—Holotype ♂, 1 ♀ paratype, ASTOVE ATOLL: Around coconut plantation, 5.iii.1968, (Cogan & Hutson) (BMNH). ALLOTYPE ♀ (BMNH), 2 ♂, 6 ♀ paratypes, ALDABRA ATOLL: South Island, Cinq Cases, 3–11.i.1968, (Cogan & Hutson) (BMNH, PARIS, USNM).

This species is dedicated to Brian Cogan, formerly of the British Museum (Nat. Hist.), in recognition of his interest in collecting the fine series of Aldabra Ceratopogonidae and in appreciation of his long and lasting friendship.

Dasyhelea cogani is closely related to *D. latiforceps* Clastrier (1983) from the Seychelles. The latter species differs mainly in the shape of the female spermatheca which is irregularly oval with stout neck, the genital sclerotization which has a stout, angulate anterior loop, male paramere which has



Figs. 30-35. *Dasyhelea hutsoni*; 30-33, female; 34-35, male; 30, antenna; 31, palpus; 32, spermatheca; 33, genital sclerotization; 34, parameres; 35, genitalia, parameres omitted.

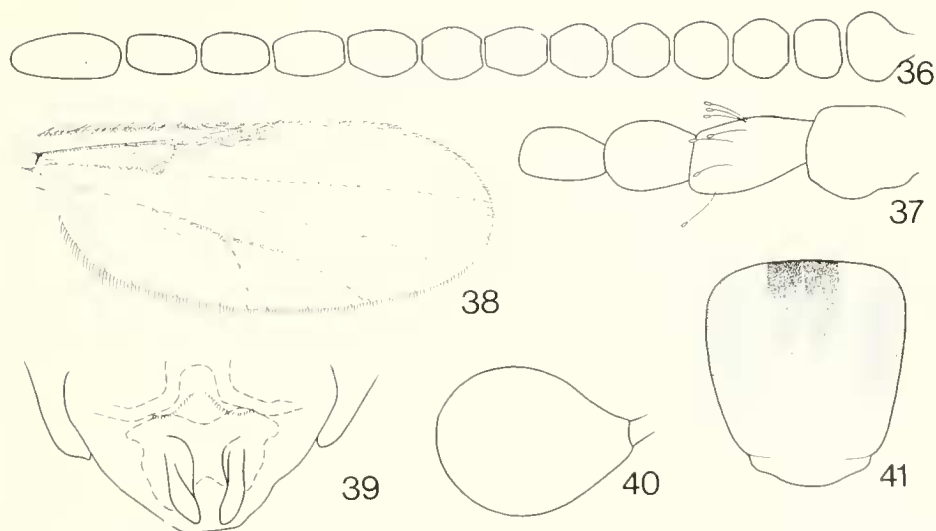
a spoonlike rather than bifurcate tip, and aedeagus which has the lateral sclerites much more slender and lacks the dorsal arcuate sclerite.

Dasyhelea hutsoni Wirth,
NEW SPECIES

Female holotype.—Wing length 0.66 mm; breadth 0.31 mm; costal ratio 0.52. Head pale brown, antennae darker brown. Antenna (Fig. 30) with lengths of flagellar segments in proportion of 27-22-23-25-25-25-26-27-36-34-32-34-56, antennal ratio 0.96; segments sculptured proximally, last segment elongate with tapering tip. Palpus (Fig. 31) short and relatively stout, lengths of segments in proportion of 19-30-15-12. Thorax pale brown, scutellum and sides of mesonotum yellowish; legs uniformly stramineous. Hind tarsal ratio 3.0. Wing smoky grayish, veins slightly darker; macrotrichia moderately numerous over entire wing, long, coarse and dark brown; first radial cell ves-

tigial, second well formed, square-ended. Halter brownish. Abdomen brownish; genital sclerotization as in Fig. 33; spermatheca (Fig. 32) one, well pigmented; oval with short oblique neck; measuring 0.054 by 0.026 mm and neck 0.009 mm long.

Male allotype.—Wing length 0.78 mm; costal ratio 0.48. Similar to the female, with the usual sexual differences. Antenna with sparse plume of long brown verticils; segments 7-12 fused; flagellar segments with lengths in proportion of 30-25-23-23-23-23-23-23-50-50-50-62, antennal ratio (12-15/3-11) 0.98. Palpus with lengths of segments in proportion of 15-30-16-17. Hind tarsal ratio 2.4. Genitalia (Fig. 35): Ninth sternum with evenly rounded posterior convexity abutting base of aedeagus; ninth tergum short and tapering, about as long as basal breadth, apicolateral processes a pair of angular lobes ending in a somewhat beadlike setigerous process, the caudal margin between the lobes deeply concaved. Basistyle somewhat swollen proximally, with-



Figs. 36–41. *Dasyhelea tamsi* female: 36, antenna; 37, palpus; 38, wing; 39, genital sclerotization; 40, spermatheca; 41, mesonotal pattern.

out special lobe or armature; dististyle about as long as basistyle, base only moderately enlarged, tapering and curved distally to moderately stout, pointed tip. Aedeagus of diagnostic shape; deeply pigmented; main body slightly broader than long, anterior margin slightly concave, with short, slender anterolateral arms; posteriorly a pair of short, stout processes tapering to blunt tips slightly turned ventrolaterad. Parameres (Fig. 34) with stout, slightly asymmetrical basal apodemes; posterior median portion swollen on proximal half with a short, strongly pigmented, slender, pointed process abruptly bent back ventrolaterad from near midlength; distal half strongly narrowed to a pointed tip directed ventrolaterad to side opposite the proximal process.

Types.—ALDABRA ATOLL: holotype ♀, allotype ♂, 4 ♂ and 1 ♀ paratypes; South Island, Takamaka Pool, 1–17.ii.1968, (Cogan & Hutson), at light; 1 ♀ paratype, Takamaka, in mangroves, otherwise same data. Ile Michel, 16.ii.1968, (Cogan & Hutson), 1 ♀ paratype. (Holotype and allotype in BMNH; paratypes in BMNH, PARIS, USNM.)

Distribution.—Aldabra.

This species is dedicated to A. M. Hutson of the Department of Entomology, British Museum (Nat. Hist.), London, in appreciation of his interest and assistance in my study of the Aldabra Ceratopogonidae.

Dasyhelea hutsoni closely resembles *D. labourdonnaisi* Clastrier (1959) from Ile Réunion in general appearance and in the structure of the male aedeagus, but the related species differs in its larger size (male wing length about 1.2 mm), straight caudal margins of the ninth sternum and tergum, the apicolateral processes of the tergum long and slender; the aedeagus with longer anterolateral arms; the dististyle tapering to more slender tip; the posterior portion of the paramere shorter and evenly tapered to the tip and lacking the retrorse proximal process, and the basal apodemes very slender and asymmetrical.

Dasyhelea tamsi Wirth & Messersmith, 1977.

Dasyhelea tamsi Wirth & Messersmith, 1977: 305 (♀; Seychelles; figs.); Clastrier, 1983: 36 (♀ redescribed from type series).

Diagnostic characters.—A small pollinose pale gray species; wing whitish with slightly darkened stigma. Mesonotum (Fig. 41) pale brown with three broad dark brownish gray vittae, humeri extensively pale yellowish gray; on slide-mounted specimens five narrow opaque lines of internal pigmentation form borders to the vittae (as noted by Clastrier 1983). Scutellum yellowish. Legs whitish, knee spots blackish. Antenna (Fig. 36) short, with segments in a continuous series, moniliform proximally to slightly elongate on distal segments, last segment without terminal stylet; surface of segments conspicuously reticulated. Palpus (Fig. 37) short and stout. Wing (Fig. 38) milky whitish, radial cells forming a dark stigma; costa ratio 0.49; veins forming radial cells greatly strengthened, the first radial cell obsolete, second short with small lumen; macrotrichia long and stout, very sparse, forming lines along veins. Halter grayish infuscated. Abdomen grayish brown, terga with pairs of small round hyaline non-pigmented spots. Genital sclerotization (Fig. 39) with slightly infuscated, quadrate, median lobe and a slender pair of oblique lateral arms. Spermatheca (Fig. 40) one, ovoid, tapering to short stout neck; heavily sclerotized; small, measuring 0.060 by 0.045 mm. Male unknown.

Distribution.—Aldabra, Seychelles.

Material examined.—ALDABRA ATOLL: South Island, Dune Jean-Louis, 13–20.iii.1968, at light, 2 ♀; Anse Cedre, 17–19.i.1968, 1 ♀; Takamaka Grove, 1–17.ii.1968, 1 ♀ (all Cogan & Hutson) (BMNH, PARIS, USNM). West Island (Ile Picard), Settlement, 12–22.iii.1986 (D. Adamski), 23 ♀ (USNM).

SUBFAMILY CERATOPOGONINAE

Tribe Culicoidini

Culicoides adamskii Wirth, NEW SPECIES

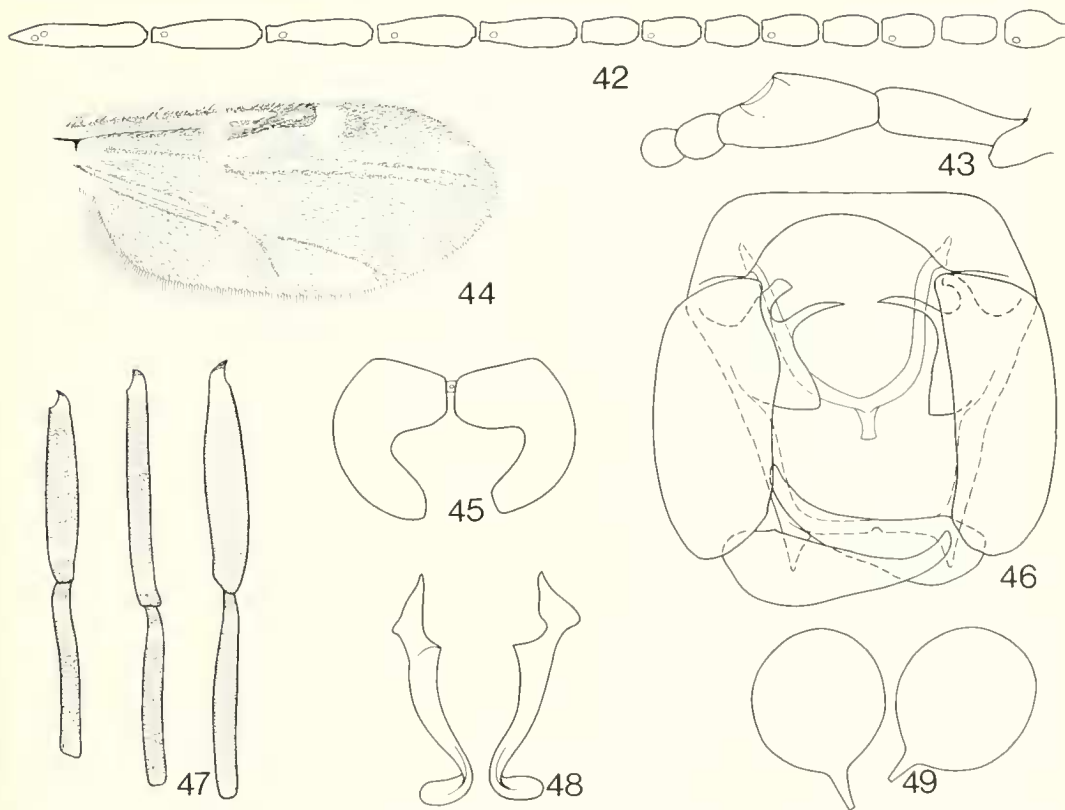
Female holotype.—Wing length 1.16 mm; breadth 0.55 mm; costal ratio 0.58.

Head: Brown, antennal flagellum yellow. Eyes (Fig. 45) bare, narrowly separated, by width of $\frac{1}{2}$ facet. Antenna (Fig. 42) with lengths of flagellar segments in proportion of 35-24-26-26-27-28-27-30-50-50-50-57-75, antennal ratio 1.25; sensilla coeloconica present on segments 3, 5, 7, 9, 11–15. Palpus (Fig. 43) dark brown; lengths of segments in proportion of 15-50-55-22-22; third segment moderately swollen distally, with a moderately large, round, moderately deep sensory pit; palpal ratio 2.02. Proboscis moderately long; P/H Ratio 0.79. Mandible with 16 teeth.

Thorax: Brown; mesonotum subshining dark brown with grayish pollinosity; three dark brown vittae, a narrow median vitta on anterior half, a pair of broad sublateral bands from humeral pits to above wing bases; a pair of small dark brown spots in pre-scutellar depression. Legs (Fig. 47) dark brown, knee spots blackish; fore and mid femora with subapical, and all tibiae with sub-basal, narrow pale rings, tarsi pale; hind tibial comb with five spines, second from spur longest.

Wing (Fig. 14, 44): Strongly infuscated, veins dark brown. Pattern as figured; two prominent but small pale spots on anterior margin, first over r-m crossvein continued cephalad to costal margin, second just past tip of costa and extending caudad half the width of cell R5; faint rounded pale spots at wing margin in each of cells R5, M1, M2, and M3+4, the latter filling distal half of cell; small pale spot at wing base just distad of basal arculus; a faint pale spot in cell M2 just behind medial fork and another just in front of mediocubital fork; anal cell with a double pale spot distally extending broadly to posterior wing margin. Macrotrichia long and coarse, abundant, covering entire wing; radial cells well-formed, with distinct lumens. Halter dark brown.

Abdomen: Brown. Spermathecae (Fig. 49) two plus sclerotized ring and vestigial third; subequal, spherical with long slender necks; each measuring 0.087 by 0.087 mm plus neck 0.032 mm long.



Figs. 42-49. *Culicoides adamski*; 42-45, 47, 49, female; 46, 48, male; 42, antenna; 43, palpus; 44, wing; 45, eye separation; 46, genitalia, parameres omitted; 47, femora and tibiae of (left to right) fore, mid and hind legs; 48, parameres; 49, spermathecae.

Male allotype.—Similar to female with usual sexual differences. Genitalia (Fig. 46): Ninth sternum with broad, shallow, caudomedian excavation, ventral membrane not spiculate; ninth tergum about as long as basal breadth, tapering to small, pointed, moderately separate, apicolateral processes, the caudal margin between them straight, with only a hint of a median notch. Basistyle about twice as long as broad, with unusual modification of mesal margin consisting of a broad, distally pointed, platelike basal lobe extending from ventral root to half the length of basistyle; ventral root long and slender, slightly curved; dorsal root curved, half as long, with blunt tip; dististyle somewhat swollen proximally, gradually tapering distally to slender, incurved tip. Aedeagus with

basal arms slender and evenly curved, forming a high slender arch to $\frac{1}{5}$ of total length; distal process small and slender, with simple tip. Parameres (Fig. 48) each with strong basal knob bearing a short anterior process, constricted a short distance just past knob; mid portion nearly straight, slightly bowed outwardly, gradually tapering distad, the short distal portion abruptly bent ventrolaterad and slightly expanded in a rounded, flattened, spoonlike tip.

Distribution.—Aldabra.

Types.—ALDABRA ATOLL: Holotype ♀, West Island (Ile Picard), Settlement, 12-22.iii.1986, (D. Adamski), in UV light trap (USNM). Allotype ♂, South Island, Dune Jean-Louis, 13-20.iii.1968 (Cogan & Hutson) (BMNH). Paratypes, 7 ♂, 36 ♀, as fol-

lows: Same data as holotype, 1 ♀; same data as allotype, 4 ♂, 4 ♀ (BMNH, PARIS, USNM). South Island, Dune D'Messe, 21.iii.1968, (Cogan & Hutson), 21 ♀; Takamaka, 1–17.ii.1968 (Cogan & Hutson), 1 ♂, 7 ♀. Middle Island, near East Channel, 6–7.ii.1968, (Cogan & Hutson), 1 ♀. West Island, near Settlement, 21–31.iii.1968, (Cogan & Hutson), 1 ♂, 1 ♀ (BMNH, PARIS, USNM).

This species is dedicated to David Adamski of Mississippi State University, who sent me a small but important collection of Aldabra Ceratopogonidae for study.

Culicoides adamskii is closely related to *C. eriodendroni* Carter, Ingram, & Macfie (1921) and *C. nigripennis* Carter, Ingram & Macfie (1920), the taxonomy of which is still in some confusion, with a number of closely related mainland Subsaharan species in the complex remaining to be described (Cornet, Glick, Meiswinkel, Phelps, in litt.). *C. adamskii* resembles *C. nigripennis* in antennal sensillar pattern 3.5,7,9,11–15, palpal proportions and shape of the sensory pit, shape and size of the spermathecae, leg color pattern and dark halter, but differs markedly in wing pattern which in *C. nigripennis* is restricted to two small anterior pale spots, and the longer costa (costal ratio 0.64) and presence of only four tibial spines in *C. nigripennis*. *Culicoides eriodendroni* resembles *C. adamskii* in wing pattern, leg pattern, and dark halter, but has antennal sensillar pattern 3,11–15, four tibial spines, and unequal ovoid spermathecae without necks.

The male genitalia of *C. nigripennis* (as figured by Boorman & Dipeolu 1979) resemble those of *C. adamskii* but have the dististyle like that of *C. eriodendroni*, basistyle like that of *C. lamborni* Ingram & Macfie (1925), and the parameres are more slender than in either species and lack the spoonlike swelling at the tip. The male genitalia of *C. eriodendroni* (as figured by Ingram & Macfie 1921) differ in the large basal swelling on the dististyle, lack of the basal

lobe on the mesal margin of the basistyle, and shorter, stouter parameres. *Culicoides lamborni*, known from the male only, has a wing pattern like that of *C. nigripennis*, and the genitalia have the dististyle and aedeagus like those of *C. adamskii*, but the parameres have a slender apex and the basistyle lacks the basal lobe.

The described species of the *C. nigripennis* Group have been reared from rot holes in various trees, and it is reasonable to expect to find the immature stages of *C. adamskii* in similar habitats.

Tribe Ceratopogonini

Metacanthohelea cogani Wirth & Grogan, 1988.

Metacanthohelea cogani Wirth & Grogan, 1988: 66 (♂, ♀; Aldabra; figs.).

Diagnostic characters.—A small, dull dark brown midge; wing length 0.90 mm. Eyes broadly separated, bare. Female antenna with distal five segments elongated; distal three segments of male antenna elongated; male antennal segments 3–10 fused, with sparse plume. Palpus 5-segmented; third segment short, swollen, with well-defined sensory pit. Legs moderately stout; hind femur swollen, bearing 14 large spines on distal half; fourth tarsomeres short but subcylindrical, bearing single apical sinuate hyaline sensillum; female claws small and equal with basal inner teeth. Wing milky, with two narrow radial cells, second 1.5 times length of first; costal ratio 0.67; vein M2 narrowly interrupted at base. Two ovoid spermathecae with oblique long slender necks. Aedeagus triangular, broad and short; parameres fused basally with long slender distal portions recurved at their tips.

Distribution.—Aldabra, Kenya.

Types.—ALDABRA ATOLL: Holotype ♀, allotype ♂, South Island, Takamaka, 1–17.ii.1968, (Cogan & Hutson) (BMNH). Paratypes, 2 ♂, 2 ♀, same data; 1 ♂, South Island, Dune Jean-Louis, at light, 13–20.iii.1968 (Cogan & Hutson); 1 ♂, West

Island, near settlement, at light, 21–31.iii.1968 (Cogan & Hutson). One ♀ paratype, KENYA, Marsabit Nature Reserve, 4200 ft, 8.xii.1969 (Irwin & Ross) (California Acad. Sci.).

Material examined.—ALDABRA ATOLL: West Island (Ile Picard); Settlement, 12–22.iii.1986. (D. Adamski), 1 ♂ (USNM).

The occurrence of this highly modified genus and species in only two widely disjunct localities.—The Indian Ocean atoll of Aldabra, and at 1250 m elevation at the Marsabit Nature Reserve in Kenya, has interesting biogeographical implications which at present are not readily explained, except to point out the close relationship of the Aldabra fauna to that of the African mainland.

Stilobezzia spirogyrae Carter, Ingram & Macfie, 1921.

Stilobezzia spirogyrae Carter, Ingram & Macfie, 1921: 325 (all stages; Ghana; figs.).

Distribution.—Aldabra, Gambia, Ghana, São Tome, South Africa.

Material examined.—ALDABRA ATOLL: Ile Michel, 3.ii.1968, 1 ♂. South Island, Cinq Cases, 3–16, 23–29.i.1968, 4 ♀; Flamingo Pool, 21–22.i.1968, 10 ♀; Frigate Pool, 20.i.1968, 1 ♂; Takamaka, Takamaka Grove, Takamaka Pool, 1–17.ii.1968, 76 ♂, 23 ♀ (all Cogan & Hutson) (BMNH, PARIS, USNM).

Tribe Sphaeromiini

Homohelea stuckenbergi (de Meillon), 1961.

Sphaeromias stuckenbergi de Meillon, 1961: 51 (♀; Madagascar; figs.).

Homohelea stuckenbergi (de Meillon); Wirth et al. 1980: 170 (combination); de Meillon & Wirth, 1981: 543 (in key).

Distribution.—Aldabra, Madagascar.

Material examined.—ALDABRA ATOLL: South Island, Cinq Cases, 23–29.i.1968, 2 ♀; Frigate Pool, 20.i.1968, 1 ♀; Takamaka, 1–17.ii.1968, 2 ♀ (all Cogan & Hutson) (BMNH, PARIS, USNM).

This species is distinguished from its Sub-Saharan congeners by its large size (wing

length more than 3.0 mm), ornamented mesonotum and abdomen, fore femur with 9 spines, mid and hind femora with 4–6 spines, and only one talon of the fore claws barbed.

Tribe Palpomyiini

Bezzia africana Ingram & Macfie, 1923

Bezzia africana Ingram & Macfie, 1923: 71 (♀; South Africa; figs.); de Meillon, 1943: 107 (♂; Transvaal; figs.); Haeselbarth, 1975: 357 (re-described; figs.; distribution; synonymy)

Distribution.—Aldabra, Cameroun, Madagascar, South Africa, Zimbabwe.

Material examined.—ALDABRA ATOLL: South Island, Takamaka Pool, 1–17.ii.1968, (Cogan & Hutson), 1 ♂.

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I am especially grateful to Brian H. Cogan and A. M. Hutson of the British Museum (Natural History) in London for their kindness in making their collections available for study, and to Richard Lane for the loan of types and for information concerning types in that museum. I wish to thank Dr. John Boorman for his kindness in examining syntypes of *Thysanognathus monostictus* Ingram & Macfie in that museum and sending photographs. I also wish to thank David Adamski of Mississippi State University, University, Mississippi, for his kindness in furnishing his ceratopogonid collections from Aldabra for study. The assistance of Molly A. Griffin in making the illustrations is gratefully acknowledged.

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